I. C. 7290

JULY 1944

RECEIVED
AUG 24 1944
U. S. U. LIBRARY

UNITED STATES
DEPARTMENT OF THE INTERIOR
HAROLD L. ICKES, SECRETARY

BUREAU OF MINES
R. R. SAYERS, DIRECTOR

INFORMATION CIRCULAR

TESTING SAFETY CATCHES ON MINE CAGES AT SOME EASTERN BITUMINOUS COAL MINES

BY

H. J. SLOMAN

Generated on 2024-09-19 14:11 GMT / https://hdl.handle.net/2027/osu.32435030643894
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

Digitized by Google

Original from
THE OHIO STATE UNIVERSITY

I.C. 7290,
July 1944.

INFORMATION CIRCULAR

UNITED STATES DEPARTMENT OF THE INTERIOR - BUREAU OF MINES

TESTING SAFETY CATCHES ON MINE CAGES AT SOME EASTERN BITUMINOUS COAL MINES[1]

By H. J. Sloman[2]

CONTENTS

	Page
Introduction	1
Types of safety catches	3
Actuating mechanisms	4
Methods of testing	4
Details of safety-catch testing methods	5
Mine A	5
Mine B	6
Mine C	7
Mine D	8
Mine E	9
Mine F	9
Mine G	11
Mine H	11
Mine I	13
Mine J	15
Mine K	16
Discussion	18
Recommended precautions	19
Acknowledgment	20

INTRODUCTION

Mining laws of the several coal-producing States with respect to safety catches on mine cages and their testing are extremely variable and generally indefinite in scope. The most specific requirements are contained in the Coal Mining Laws of Washington,[3] as follows:

[1] The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is used: "Reprinted from Bureau of Mines Information Circular 7290."

[2] Senior mining engineer, Bureau of Mines, Health and Safety Service, Pittsburgh, Pa.

[3] Department of Labor and Industries, Coal Mining Laws of Washington as Amended 1919, 1927, 1939 and 1943: Secs. 62 and 64.

0333

Generated on 2024-09-19 13:50 GMT / https://hdl.handle.net/2027/osu.32435030643894
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

Digitized by Google

Original from
THE OHIO STATE UNIVERSITY

Each cage must be equipped with efficient safety catches to prevent the cage from falling down the shaft in the event of the rope breaking***.

The following tests of safety catches on cages shall be made once every 6 months. The cage shall be secured by passing a heavy hemp rope through the bridle chain ring or link and fastening both ends of the rope to guides or to diagonally opposite posts of head frame, drawing the rope taut. A blocking to be passed below the cage to support same before hoisting rope is taut. The hoisting engineer shall then slack away until the cage is suspended on the hemp rope with at least four feet of the slack hoisting rope on top of it. Everything being in readiness the hemp rope shall be suddenly cut. If the safety catches stop the cage before it rests upon the blocking, the apparatus shall be considered efficient.

The Pennsylvania[4/] bituminous mining law states, with regard to safety catches:

***and shall also provide for each said cage efficient safety catches, which shall be tested once every two months, and a record of each test shall be sent to the inspector and to the superintendent and also recorded with ink in a book kept at the mine office for that purpose.

The Washington law is somewhat more specific as to what the test shou include, but it requires such a test once every 6 months, whereas, the Pennsylvania bituminous law requires the test once every 2 months.

Other mining laws require the use of safety catches and examination thereof but contain nothing specific regarding the details of safety-catch tests nor the time that may elapse between tests.

The Utah Coal Mine Safety Orders[5/] state:

The safety apparatus, whether consisting of eccentrics, spring or other device, must be securely fastened to the cage, and of sufficient strength to hold the cage loaded at any depth to which the shaft may be sunk.***. Sufficient safety catches shall be attached to***and shall be provided on every cage used for lowering or hoisting persons in any shaft. The***safety catches***shall be carefully examined every day that they are used by a competent person and any defect therein found shall be immediately remedied.

The Ohio[6/] mining law states:

4/ Pennsylvania, Bituminous Mining Laws: Art. VIII, sec. 1, 1940.
5/ Industrial Commission of Utah, General Coal Mine Safety Orders: Sec. 27, 1937.
6/ Ohio, Mining Laws: Secs. 898-59, 898-62, effective Sept. 2, 1941.

Generated on 2024-09-19 13:51 GMT / https://hdl.handle.net/2027/osu.32435030643894
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

The owner, lessee or agent of a mine shall provide and maintain safe appliances, approved by the deputy inspector for the ingress and egress of persons in each shaft.***. The cages operated in said shaft shall have an approved safety catch***.

The Pennsylvania anthracite law[7] requires:

efficient safety catches shall be attached toevery cage used for lowering or hoisting persons in any shaft.***. The ***safety catches***shall be examined carefully every day they are used, by a competent person delegated for that purpose, and any defects therein found by which life or limb may be endangered, shall be immediately remedied.

Less definite statements contained in the Indiana[8] law are: "Approved safety catches shall be attached to every cage used for the purpose of hoisting or lowering persons;" and for Colorado:[9] "They [the cages] shall be equipped with approved safety catches." The mining laws of other States either contain similar statements or make no reference to the requirements for safety catches on mine cages.

TYPES OF SAFETY CATCHES

This investigation was confined to methods of testing safety catches on mine cages utilized for hoisting men, and it did not include cages on which men are not transported. The study disclosed two general types of safety catches on the cages inspected, as follows:

1. Cam-shaped dogs with serrated (toothed) surfaces for contact with cage guides. The dogs are attached to the extremities of two jack shafts, so that two safety catches will operate on each guide, or a total of four for each cage. When actuated, the safety catches turn inward and, because of their eccentricity, grip the cage guides.

2. Wedge-shaped safety catches with one serrated face, which is the one permitted to contact the cage guides. These safety catches are wedge-shaped steel castings that vary in size according to the cage design. A common size is approximately 16 inches long by 4 inches wide by 4 inches at the thick end, tapering to 1/2 inch at the thin end. Two safety catches are necessary for each guide, or four for each cage. When actuated, the safety catches slide upward in a retaining shoe and wedge themselves into the space between the guide and the retaining shoe.

7/ Pennsylvania, Anthractie Mining Laws: Secs. 10 and 13, 1941.
8/ Indiana, Mining Laws: Sec. 16, 1941.
9/ Colorado, Coal Mining Laws: Sec. 3523.

Generated on 2024-09-19 13:51 GMT / https://hdl.handle.net/2027/osu.32435030643894
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

ACTUATING MECHANISMS

1. The cam-shaped safety catches (dogs) are kept disengaged from the cage guides by tension in the hoisting rope. The hoisting-rope tension is transferred to two jack shafts by a system of levers, which terminates in a right-hand and a left-hand bell crank. One jack shaft is connected to the right-hand bell crank and the other to the left-hand bell crank, so that under normal hoisting conditions each jack shaft is rotated a fraction of one revolution clockwise and counterclockwise, respectively. This rotation is sufficient, with tension in the hoisting rope, to turn the safety catches away from and out of contact with the cage guides. Should a failure occur, such as the breaking of the hoisting rope or some attachment thereto, the jack-shaft spring will cause the jack shafts to rotate. During rotation opposite safety catches turn inward toward each other and, because of the eccentricity of their shape and the downward motion of the cage, wedge themselves into the guides and suspend the cage in the shaft.

2. The wedge-shaped safety catches are actuated by a system of levers and fulcrums of varying design; their functioning is essentially the same. In normal hoisting operations, with tension in the hoisting rope, the safety catches (wedges) are held in a "down" or disengaged position by the system of levers and fulcrums. An actuating spring, which is connected by a kingpin to the main draw-bar connection of the cage, is in compression when tension is in the hoisting rope. Each safety catch has its movement controlled by a retaining shoe made of angle iron with a slot about 6 inches long cut in one leg. A square-head stud bolt has its shank extended through the slot and screwed into the safety catch so that the square head of the bolt slides in the slot when the safety catch functions and controls the extent of its movement. The face of the slot on which the square head slides is sometimes recessed to prevent the bolt from rotating and thus permits the safety catch to move in a straight line only. The slotted shoes, one for each safety catch, are mounted inclined with the vertical on the superstructure of the cage, so that when the safety catches function, they are guided in a manner to permit a wedging action. The wedge-shaped safety catch moves upward when functioning, and the 6-inch travel permitted by the slotted retaining shoe gives impetus to the movement of a safety catch.

METHODS OF TESTING

Three general methods are followed in testing the effectiveness of the safety-catch action:

1. The rope is disconnected from the cage by inserting a "knock-off" device between the rope connection and the main drawbar of the cage. This method simulates the failure of a hoisting rope and subsequent release of the cage.

2. The rope is not disconnected from the cage for the test. The compression, or tension as the condition may be, of the actuating spring is transferred to some other medium, such as a releasing pin, which is part of a release mechanism. In other instances, the spring pressure is transferred

Generated on 2024-09-19 13:50 GMT / https://hdl.handle.net/2027/osu.32435030643894
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

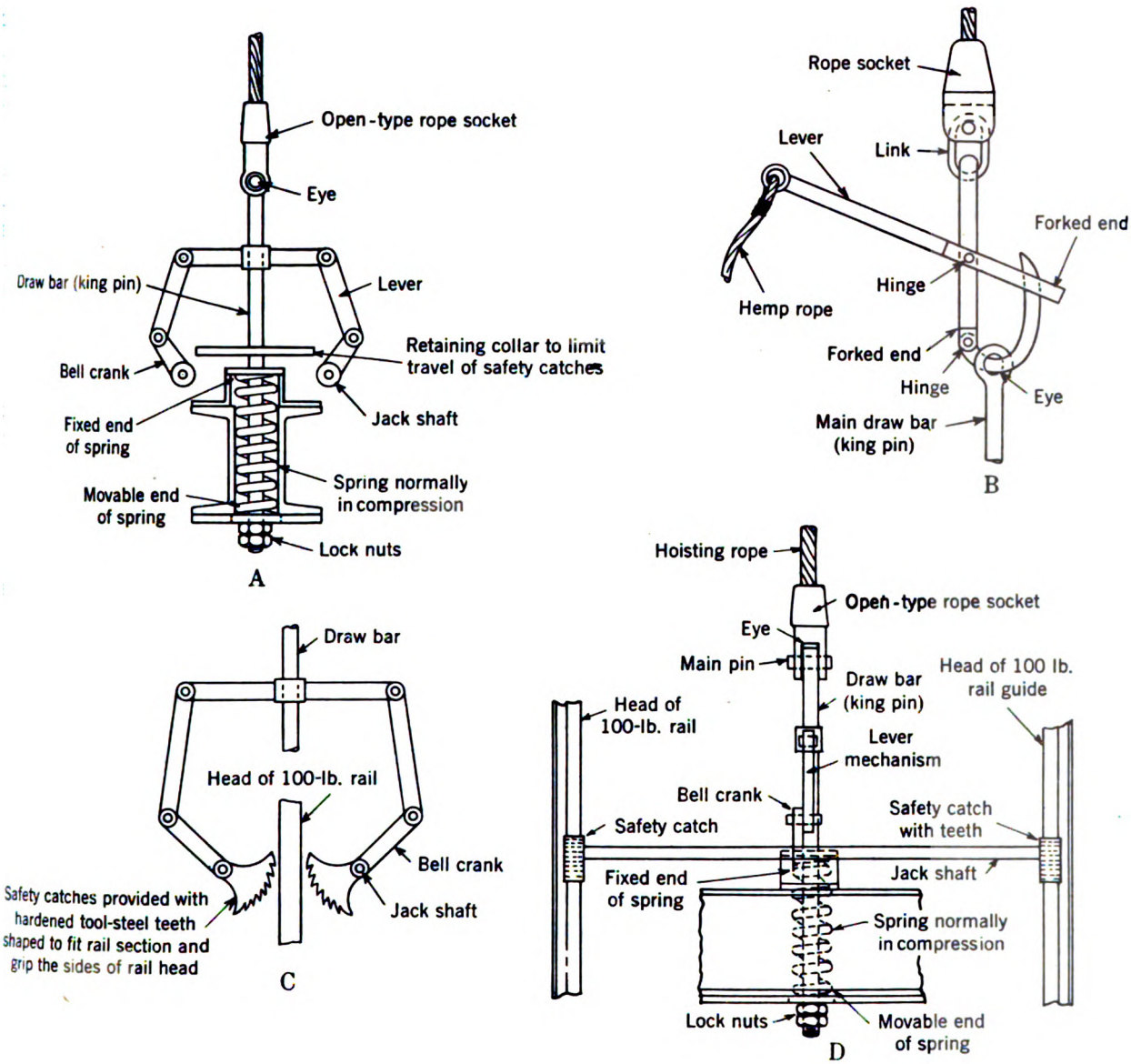

Figure 1.- A, Safety catch-actuating mechanism; B, Knock-off device; C, Safety catches in position to grip guide; D, Jack shaft with safety catches in position (near side) and actuating mechanism. Mine A.

Generated on 2024-09-19 13:51 GMT / https://hdl.handle.net/2027/osu.32435030643894
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

to a lifting jack, which may be jerked away during a downward movement of the cage and thus permit the safety catches to function.

3. A test less severe than that explained in statement 2 is one in which the spring's kingpin is disconnected from its normal connection, allowing the safety catches to turn in position to grip the guides. Subsequent lowering of the cage permits the safety catches to tighten and grip the guides and suspend the cage in the hoisting shaft.

The methods of testing described in statements 2 and 3 have the advantage of obviating the necessity of blocking the shaft as a precaution against failure of the test, because the main rope and bridle-chain connections are not disturbed.

The tests are conducted at the top of the shaft in some instances and at the bottom in others.

DETAILS OF SAFETY-CATCH TESTING METHODS

Mine A

Figure 1 illustrates the method of testing safety catches on a cage equipped with cam-shaped safety catches which, when actuated, grip the sides of the head of a 100-pound rail used as a cage guide. The rope is released from the cage in this test.

The hoisting rope is attached to the cage with an open-type rope socket, which is pin-connected to an eye in the main drawbar. The opposite end of the main drawbar serves as a kingpin for the spring, which is in compression during normal hoisting operations with tension in the hoisting rope. The two jack shafts are rotated a fraction of a revolution during normal hoisting, so that the safety catches are out of contact with the cage guides.

An empty cage is raised above the surface landing of the shaft, and two 10- by 10-inch timbers are placed across the shaft. The hoisting engineer is signaled to lower the cage until it rests upon the timbers.

Two workmen, wearing safety belts, mount the cage bonnet, and a signal is given the hoisting engineer to slack the rope. The rope-socket and bridle-chain connections are removed by the workmen. A link and a hinged knock-off hook are inserted, the link being connected to the rope socket by a pin and the knock-off hook being attached to the eye of the main drawbar. A pivoted lever is attached to the knock-off hook; one end of the lever serves as a retaining bail; and the other end has a hemp rope attached to it for releasing the hook. After insertion of this attachment, the men leave the cage, and one of them stands on a horizontal member of the head frame. The hoisting engineer is signaled to raise the cage to about 6 inches above the 10 by 10 timbers so that tension is in the main drawbar. The workman on the head frame actuates the knock-off hook by a downward jerk on the hemp rope attached to the lever. The safety catches function and hold the cage. The workmen then remount the cage bonnet and the hoisting rope is again slacked sufficiently

Generated on 2024-09-19 14:00 GMT / https://hdl.handle.net/2027/osu.32435030643894
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

to disconnect the knock-off hook and link. The rope socket is reconnected to the eye of the main drawbar, and the bridle chains are replaced in their proper position. The hoisting engineer is signaled to raise the cage; the actuating spring for the jack shafts is recompressed when tension is in the hoisting rope, and the safety catches are released. The timbers are removed from across the shaft, and normal hoisting is resumed.

One cage dropped 5 inches, when the safety catches functioned and held it; the other cage was suspended after a 2-1/4-inch drop in successive tests

Mine B

The safety-catch actuating mechanisms and method of testing at the mine B are illustrated in figure 2. Hoisting was in balance, but the cages were dissimilar in design; this accounts for the two illustrations. The cages are equipped with cam-shaped safety catches, which, instead of having the usual horizontal serrations, have two rows of square-shank tapered teeth, four teeth in each row. Both jack shafts on each cage are actuated by a single vertical spring, which is compressed during normal hoisting through a kingpin connection to the main drawbar. The safety catches are kept disengaged from the wooden guides by the tension in the hoisting rope through levers and right- and left-hand bell cranks. The differences in the details of the mechanisms are shown in figure 2.

Both cages are tested empty at the top of the hoisting shaft. The shaft is not blocked, because the main rope is not released from the cages during the test.

To release the jack-shaft connection, two workmen on the cage deck further compress the vertical spring by a lifting jack, which is supported on the cage deck. Another workman mounts the bonnet of a cage and (for No. 1 cage) releases the jack-shaft connection to the main drawplates by removing the pin connection from the bottom of the chain that connects the safety catch-actuating mechanism to the main drawplates. The clevis-pin connection to the triangular forging is removed on the No. 2 cage; this releases the jack-shaft connection. The jack is removed, and the jack shafts, rotated by the spring, place the safety catches in position to grip the guides. The cages are tested separately, and in each instance the hoisting engineer is signaled to lower slowly; whereupon, the safety catches, because of the downward movement of the cage, tighten against and grip the guides and hold the cage. Slack was observed in the hoisting rope and main and bridle chains indicating that all safety catches were functioning. No. 1 cage dropped 2-3/4 inches and No. 2 cage dropped 2-1/2 inches when the safety catches functioned.

After the safety catches operated, two workmen went to the cage deck and recompressed the spring with the lifting jack, so that a third workman on the cage bonnet could reset the pin, which had been removed for the test. The hoisting engineer was signaled to raise the cage, and, when tension was in the hoisting rope, the safety catches were disengaged and normal hoisting could be resumed.

Generated on 2024-09-19 13:49 GMT / https://hdl.handle.net/2027/osu.32435030643894
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

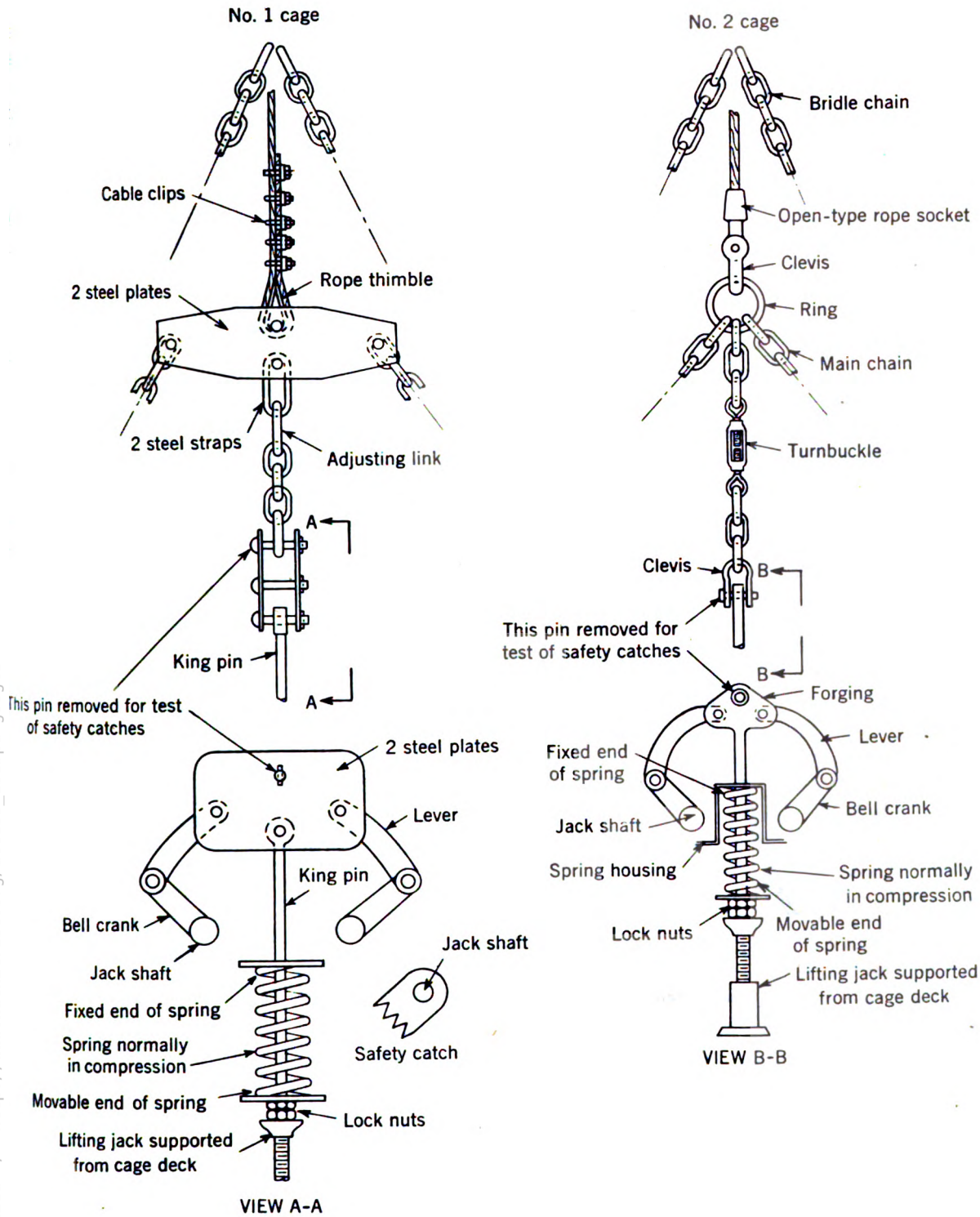

Figure 2.- Safety-catch tests. Mine B.

Generated on 2024-09-19 13:50 GMT / https://hdl.handle.net/2027/osu.32435030643894
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

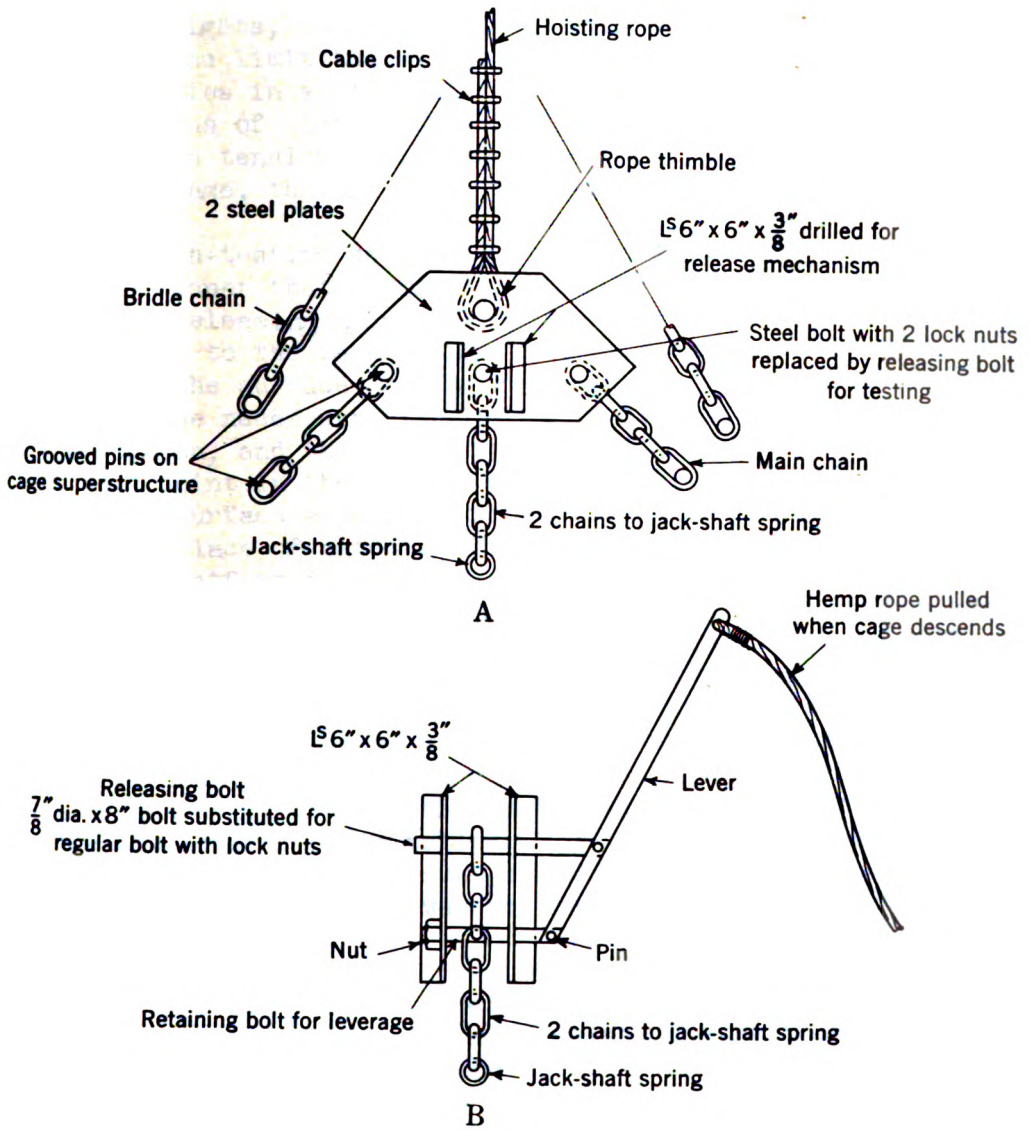

Figure 3.- A, Cage connections; B, Releasing mechanism for testing cage safety catches. Mine C.

Generated on 2024-09-19 13:49 GMT / https://hdl.handle.net/2027/osu.32435030643894
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Mine C

Figure 3 illustrates the main drawbar attachments and the releasing mechanism for testing the safety catches on mine cages at mine C. The hoisting rope is attached to the cage by means of a thimble and seven cable clips. Wooden cage guides are installed. The cage is equipped with cam-shaped, toothed safety catches, which have fins cast on each to serve as counterweights, which assist the gripping action when the safety catches function and limit the extent of their movement. The jack-shaft actuating spring lies in a horizontal plane and is attached to the two jack shafts by means of right- and left-hand bell cranks. The spring is in compression when tension is in the hoisting rope and, for normal operation of the cage, the safety catches are disengaged from the guides.

A safety catch-testing device is attached to the superstructure of an empty cage in a manner that permits the transfer of the jack-shaft spring compression to a releasing pin without disturbing either the main-rope thimble connection to the cage or the bridle-chain connections. The cage is lowered below the surface landing, so that two workmen can mount the bonnet and make the necessary attachments to the cage. Safety belts are worn by the workmen, and their safety ropes are attached to the head frame. At this point in the test, the workmen leave the cage and take positions on the surface adjacent to the shaft so as to actuate the release mechanism from a place of safety. The cage is then raised in the head frame until the platform is about 10 feet above the surface landing and is brought to rest. The hoisting engineer is signaled to lower the cage, and the pin-releasing mechanism is operated by one of the workmen pulling on a hemp rope attached to the releasing lever after the cage has descended 4 or 5 feet. When the pin is withdrawn, the spring is released, the jack shafts rotate toward each other a fraction of one revolution, and the safety catches turn toward the guides and grip them. This operation takes place almost instantaneously, because the cage does not descend more than 3-1/2 inches after the lever rope is pulled. The entire weight of the cage is borne by the safety catches, because slack in the hoisting rope was noted, indicating that the cage weight was not being supported by the rope after the safety catches functioned.

The hoisting shaft was not blocked to prevent descent of the cage if the safety catches had not functioned, because the main hoisting rope was not disconnected from the cage during the tests. The hoisting engineer could stop the cage, did the safety catches fail to grip the guides.

After the safety catches have functioned, the two workmen again go to the top of the cage, compress the spring to release the safety catches, and replace the releasing pin with the original pin, which keeps the jack shafts in position for normal hoisting. The entire releasing mechanism is removed from the top of the cage, the workmen descend, and normal hoisting operations are resumed.

Generated on 2024-09-19 13:50 GMT / https://hdl.handle.net/2027/osu.32435030643894
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Mine D

The cage connections for main chains, bridle chains, and jack-shaft springs are shown in figure 4. The hoisting rope is attached to the cage by a spelter-filled socket, and the two jack shafts are actuated by two vertical springs, one for each jack shaft, which are in compression when tension is in the hoisting rope. Wooden cage guides are installed throughout the hoisting distance. Cam-shaped safety catches are at each extremity of the two jack shafts, and they grip the guides when the safety mechanism functions.

A releasing device similar to that in figure 5 is attached to the superstructure of the cage when safety catches are to be tested. This device permits transfer of the compression in the jack-shaft springs to a releasing pin without disturbing either the main rope-socket connection or the bridle-chain connections. The releasing device is installed by two workmen, who mount the top of the cage after the hoisting engineer has placed the cage in a convenient position near the surface landing. The workmen wear safety belts and attach their safety ropes to a substantial member of the steel head-frame structure. The workmen then leave the top of the cage and take positions on the surface adjacent to the shaft so as to actuate the release mechanism from a place of safety.

The hoisting engineer is signaled to lower the cage and, when the cage bonnet is about at the level of the surface landing, one of the workmen actuates the releasing mechanism by giving a quick, downward jerk on the hemp rope attached to the releasing lever. This action results in a quick withdrawal of the releasing pin; the jack-shaft springs expand; and the safety catches grip the guides. The operation takes place almost instantaneously, because the safety catches functioned after one cage had dropped 1-1/2 inches and the other had dropped 3 inches. In each test, slack was noted in the hoisting rope and bridle chains, indicating that the safety catches were bearing the weight of the cage after the release mechanism operated.

After the safety catches have functioned, the two workmen again go to the top of the cage, compress the springs with a steel pinch bar to release the safety catches from the guides, and replace the releasing pin with the original pin, which keeps the jack-shafts and safety catches in proper position for normal hoisting. The entire releasing mechanism is removed from the top of the cage, the workmen descend, and normal hoisting operations can be resumed.

The hoisting shaft is not blocked because the hoisting rope was not disconnected from the cage to make the test. If the safety catches should fail to function, the hoisting engineer could stop the cage, necessary adjustments or repairs could be made, and the test could be repeated.

Generated on 2024-09-19 13:50 GMT / https://hdl.handle.net/2027/osu.32435030643894
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

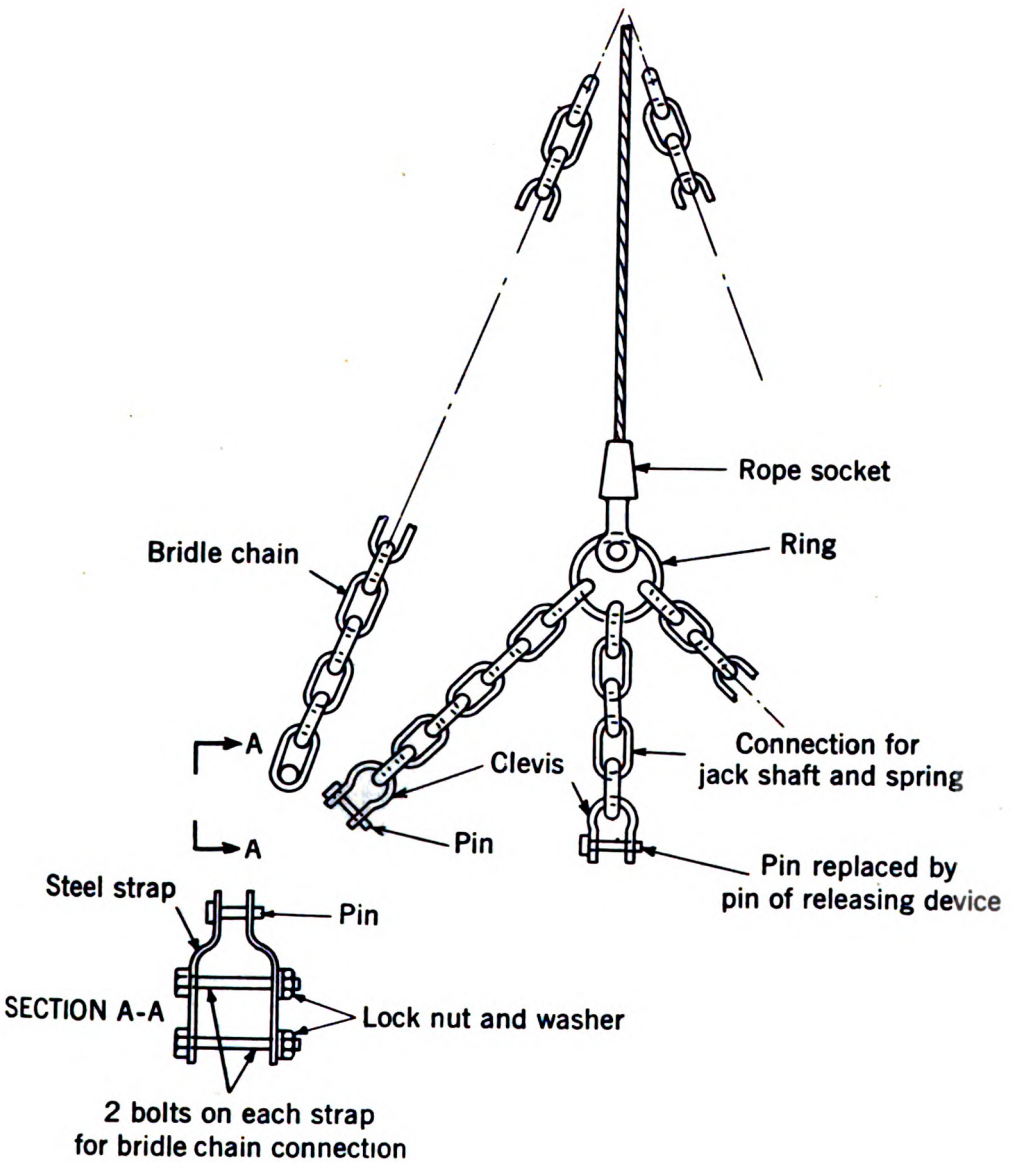

Figure 4.- Safety-catch test. Mine D.

Generated on 2024-09-19 13:50 GMT / https://hdl.handle.net/2027/osu.32435030643894
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from
THE OHIO STATE UNIVERSITY

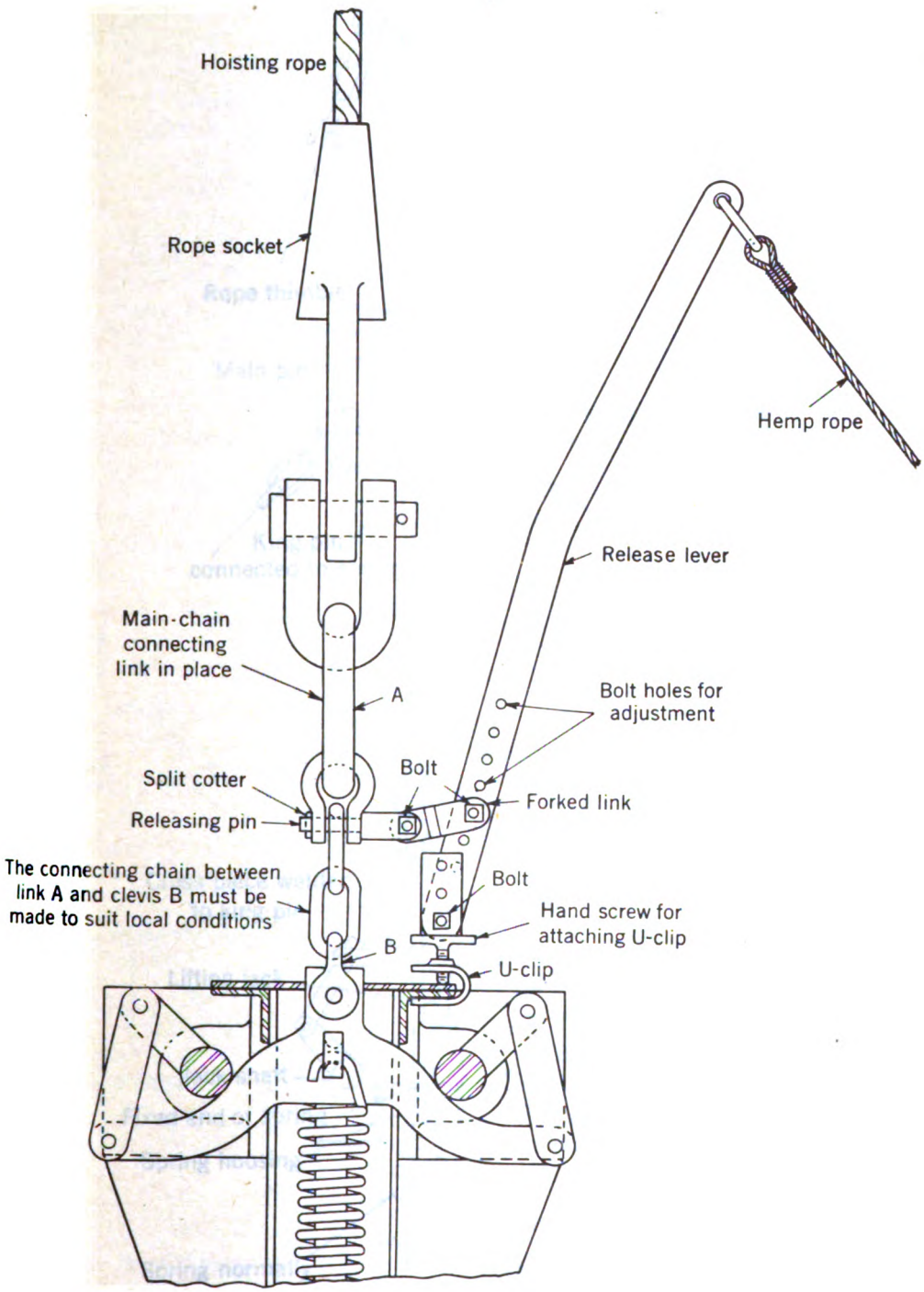

Figure 5.- Releasing device for testing safety catches on mine cage.

Generated on 2024-09-19 13:54 GMT / https://hdl.handle.net/2027/osu.32435030643894
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

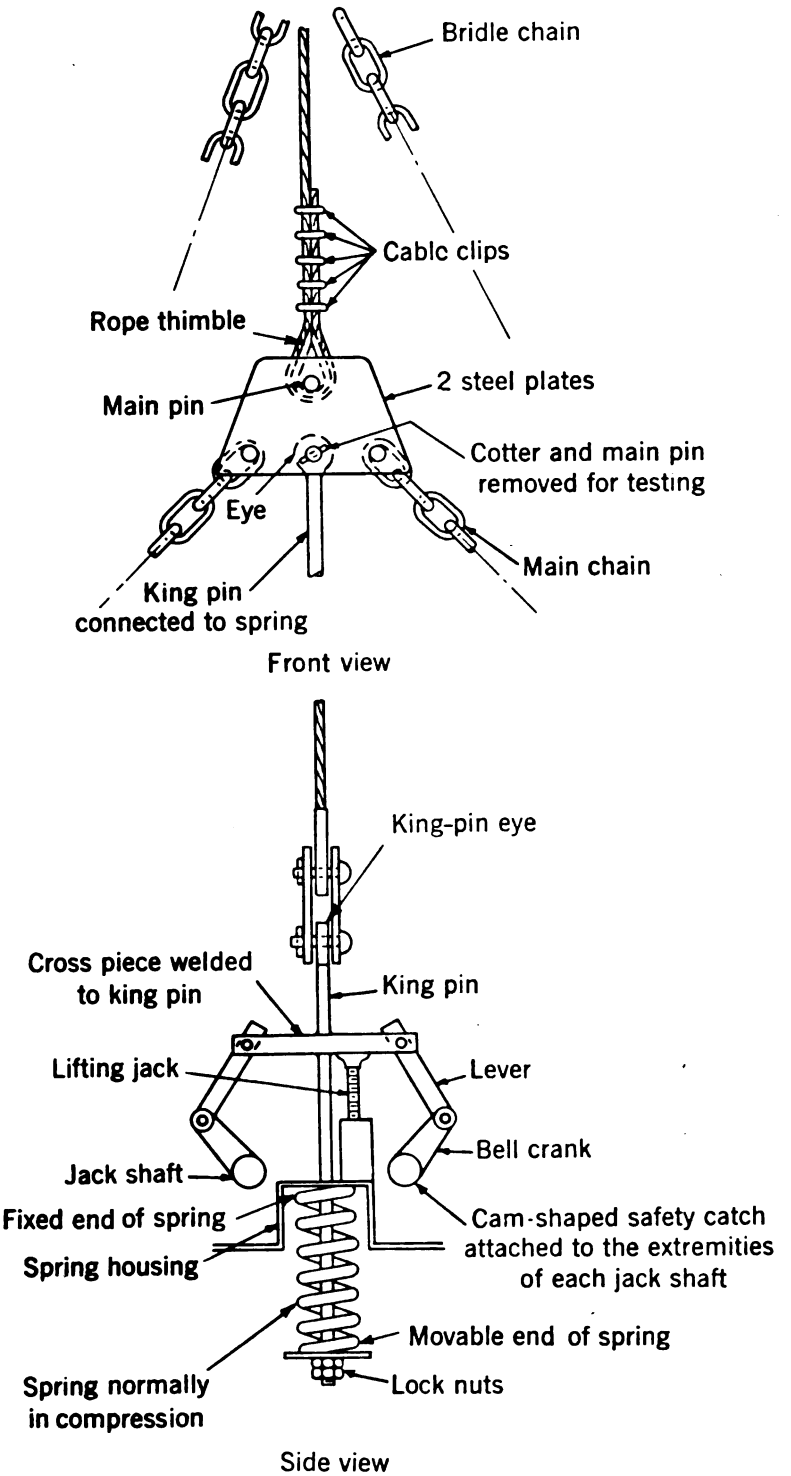

Figure 6.- Safety-catch mechanism. Mine E.

Generated on 2024-09-19 13:52 GMT / https://hdl.handle.net/2027/osu.32435030643894
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from
THE OHIO STATE UNIVERSITY

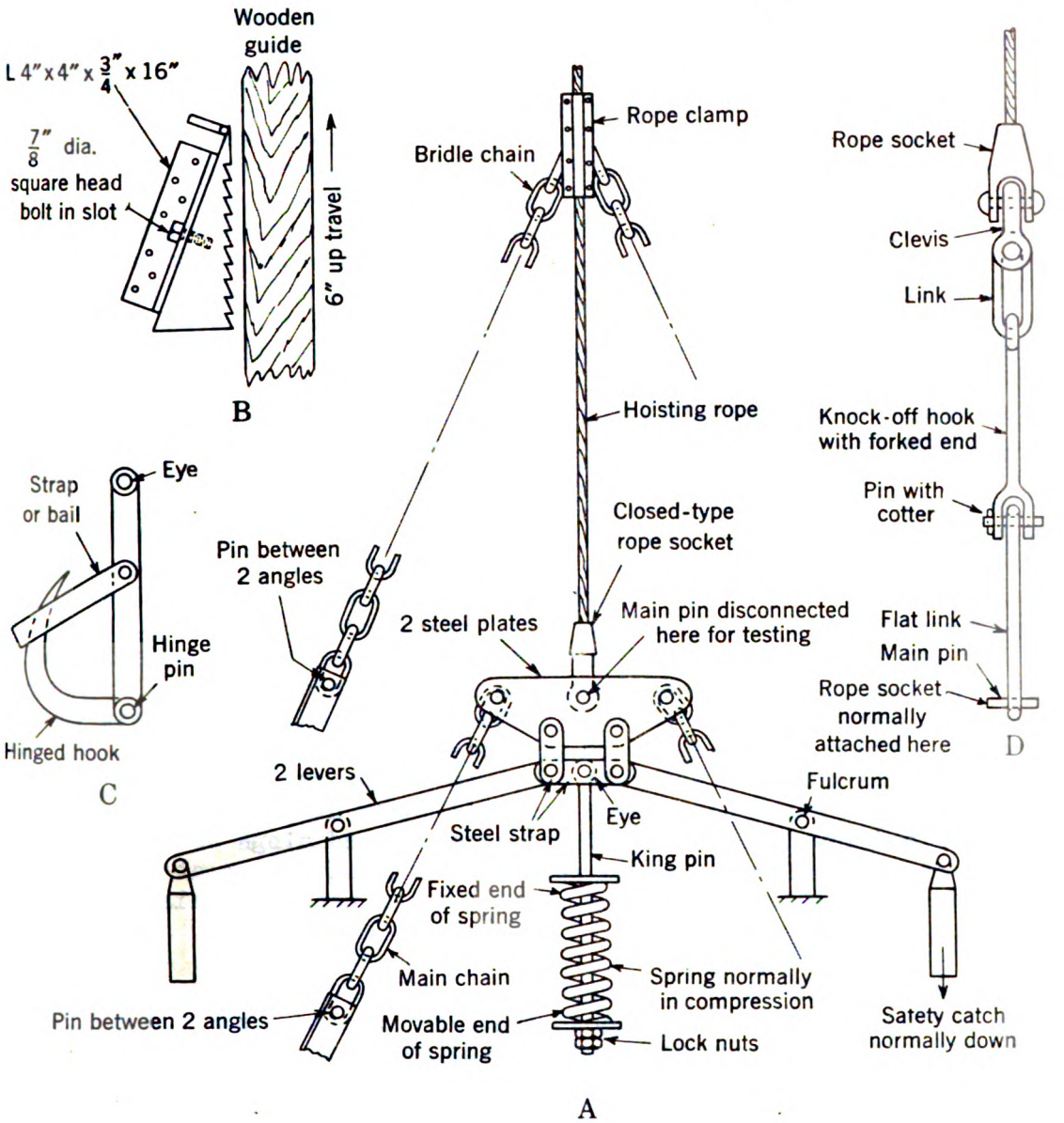

Figure 7.- A, Safety-catch mechanism; B, Safety-catch detail; C, Knock-off hook; D, Knock-off device, Mine F.

Generated on 2024-09-19 13:51 GMT / https://hdl.handle.net/2027/osu.32435030643894
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Mine E

The rope, main-chain and bridle-chain connections, and the arrangement for testing safety catches are shown in the two views of figure 6. The hoisting rope is attached to the cage by a thimble with eight cable clips to two steel drawplates through a main pin connection. Cam-shaped safety catches with toothed surfaces are installed at the extremities of two jack shafts and are arranged so that when functioning they will grip wooden cage guides. The jack shafts are actuated when tension is released from the hoisting rope by a system of levers and bell cranks through a single vertical spring in compression. Under normal hoisting conditions, with tension in the hoisting rope, the jack shafts are rotated enough to keep the safety catches disengaged from the cage guides. The spring action is controlled by a kingpin whose upper end terminates in an eye, which is connected to the main drawplates. The kingpin and drawplates are in tension when the cage is suspended on the hoisting rope. A steel bar is welded to the kingpin as shown in the diagram and is an integral part of the lever mechanism.

The hoisting rope is not disconnected from the cage to test the safety catches, and therefore the hoisting shaft is not blocked. Two workmen mount the cage bonnet and, with a lifting jack between the top of the vertical spring housing and the T-connection to the kingpin, further compress the spring by raising the kingpin, so that the kingpin bolt (pin connection to the two main plates) can be removed. After removal of this bolt (pin), the lifting jack is removed, and the jack shafts, rotated by the spring, place the safety catches in position to grip the guides. After the workmen leave the top of the cage, the hoisting engineer is signaled to lower the cage, whereupon the safety catches tighten and grip the guides. It was observed that slack was in both the main and bridle chains and all safety catches functioned in the test, thereby suspending the cage in the shaft. The engineer is signaled to raise the cage, so that the hoisting rope is in tension. The workmen again mount the cage bonnet and "jack up" the kingpin so that its eye can again be pin-connected to the main drawplates. After this connection is made, the engineer is signaled to raise the cage a short distance, the safety catches are released, and normal hoisting can be resumed.

The catches can be tested at any convenient point; this test was conducted at the surface landing. One cage dropped 1 inch and the other 3 inches, in successive tests, when the safety catches functioned and held.

Mine F

Figure 7 illustrates the actuating mechanism for wedge-shaped safety catches, a detail of a wedge, and the "knock-off" device in use at this mine.

The hoisting rope is attached to the cage by means of a closed-type rope socket, pin-connected to two steel drawplates. Wedge-shaped safety catches, two for each guide or four to a cage, are installed. Each wedge has a serrated face for contact with a wooden guide when the safety catches

Generated on 2024-09-19 13:51 GMT / https://hdl.handle.net/2027/osu.32435030643894
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

function. The catches are mounted on each cage in such a manner that when a pair is in the gripping position, their serrated faces would be only 2-3/4 inches apart if no guide intervened for them to apply the "bite" of the contact faces. In this instance, the wooden guides had cross-section dimensions of 5 by 8 inches and were installed so that the 5-inch thickness was between each pair of safety catches.

The safety catches are actuated by a system of levers and fulcrums. In normal hoisting operations with tension in the hoisting rope, the catches are disengaged and held in a "down" position. An actuating spring, which is connected by a kingpin to the main drawbar connection of the cage, is compressed between two steel plates when tension is in the main hoisting rope. Each safety catch is guided by a slotted shoe made of 4- by 4- by 3/4-inch angle iron about 16 inches long, with a 6-inch slot. A square-head bolt is attached to the safety catch, and the head of the bolt slides in the slot when the safety catch functions and controls the extent of its movement. The slotted shoes are mounted on the cage inclined at an angle, with the vertical so that when the safety catches function they are guided in a manner to permit a wedging action, and the 6-inch travel in the slot gives an impetus to the action of the wedge-shaped safety catch, which moves "up" when functioning.

The test for effectiveness of the safety catch is conducted at the shaft bottom. The bridle chains are released at the surface before the test cage is lowered to the shaft bottom. A shallow sump is at the bottom of the shaft, and two bales of hay are placed in it; one bale is adjacent to each guide. The cage is lowered, upon signal to the hoisting engineer, until it rests upon the two bales of hay; this allows the cage deck to descend to 6 inches above the bottom landing and gives slack in the hoisting rope. A workman mounts the top of the cage and disconnects the rope socket from the main pin connection to the cage. A knock-off device is inserted between the rope socket and the cage. The knock-off device consists of a clevis (attached to rope socket), a 7/8-inch-diameter by 6-inch-long link, a hinged knock-off hook with a retaining strap, and a 16-inch flat link connected to the main pin on the cage.

The hoisting engineer is signaled to raise the cage a short distance, and the workman on the cage steps off onto a horizontal shaft timber. The workman then strikes the retaining strap with a short iron bar, releasing the knock-off hook and, in turn, the rope is released and the safety catches function.

Both cages were tested empty. One cage dropped 6 inches and the other dropped 9 inches in successive tests. All safety catches gripped the guides.

The workman remounted the cage, disconnected the knock-off attachment, reconnected the rope socket, and descended to the shaft bottom. The hoisting engineer was signaled to raise the cage; the safety catches were released when tension was applied to the hoisting rope, and normal hoisting could be resumed.

Generated on 2024-09-19 13:52 GMT / https://hdl.handle.net/2027/osu.32435030643894
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

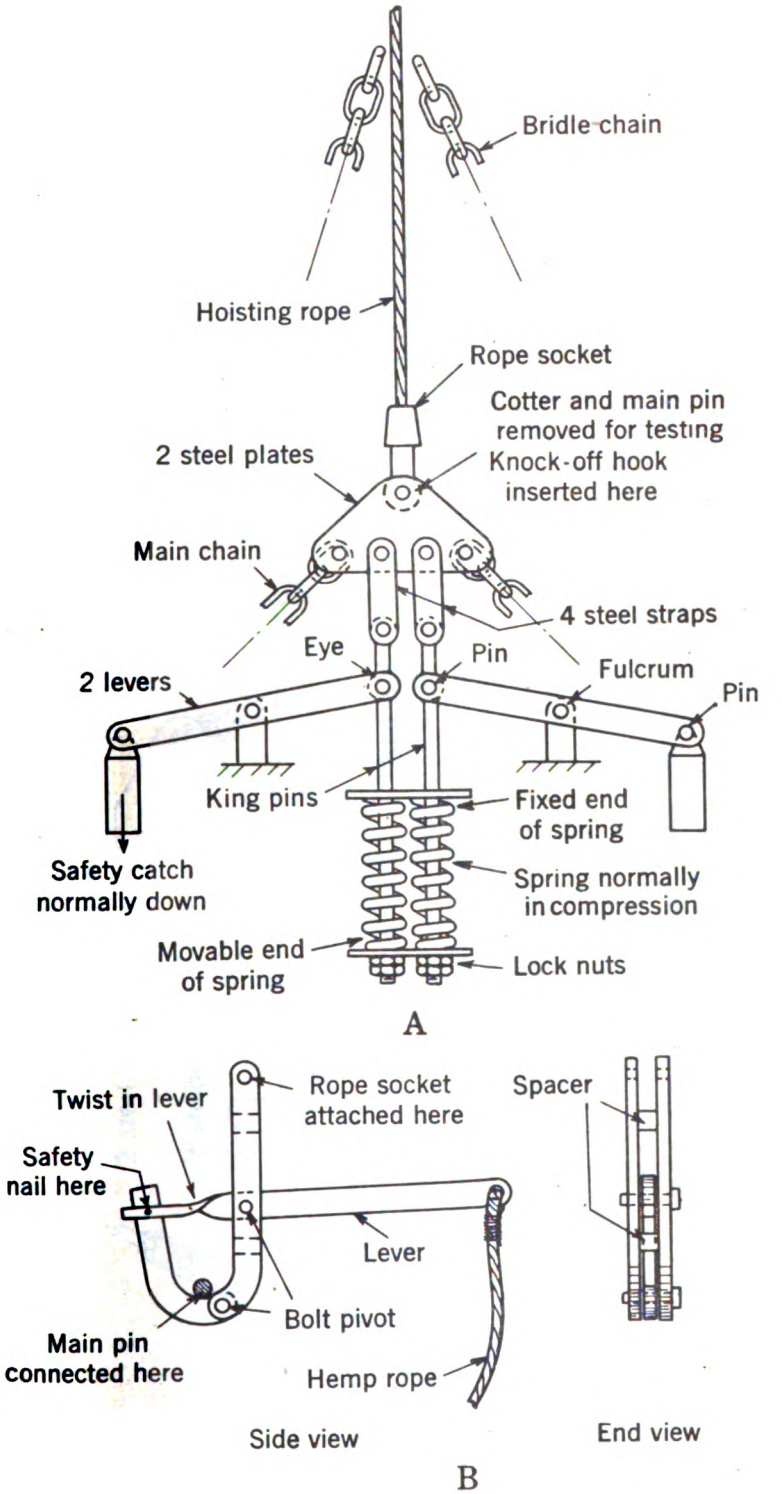

Figure 8.- A, Safety catch-actuating mechanism; B, Knock-off device. Mine G.

Generated on 2024-09-19 13:52 GMT / https://hdl.handle.net/2027/osu.32435030643894
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Generated on 2024-09-19 13:50 GMT / https://hdl.handle.net/2027/osu.32435030643894
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

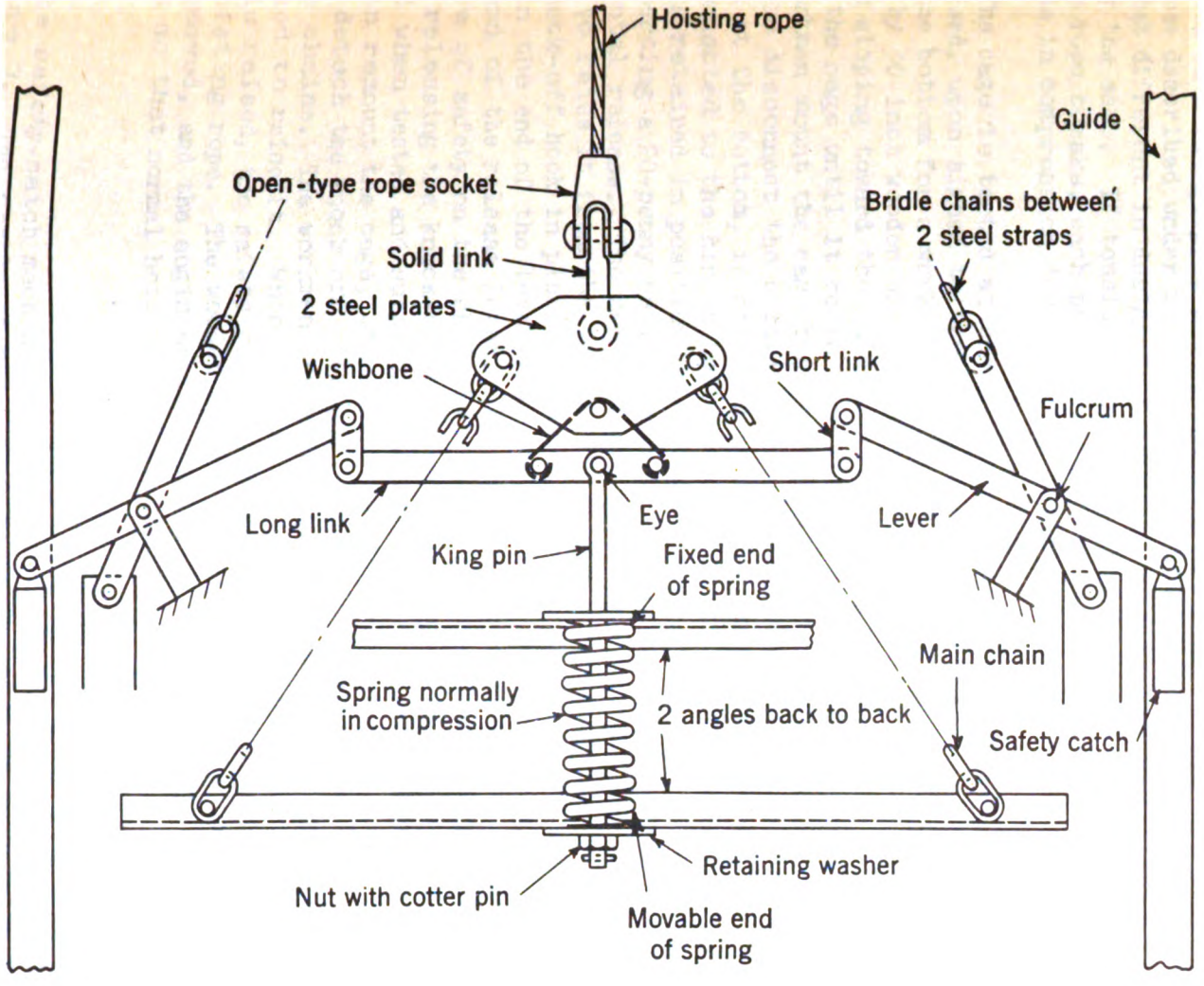

Figure 9.- Safety-catch mechanism. Mine H.

Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Mine G

The safety-catch mechanism and the "knock-off" device utilized in the test for the man cage at this mine are illustrated in figure 8. The rope is attached to the cage by a closed-type rope socket pin-connected to two main drawplates, from which two main chains extend to the main cross beam.

The cage is equipped with wedge-shaped safety catches similar in design to those described under mine F. The details of the lever mechanism are somewhat different in design from those at mine F, but the action is essentially the same. If tension is released from the rope, such as would occur if the rope breaks, each pair of safety catches will be actuated by a spring that is in compression during normal hoisting.

The cage is tested at the bottom of the man-and-supply shaft. The cage is raised, upon signal to the hoisting engineer, until it is far enough from the bottom for a workman to place two wooden blocks beneath it. Two 4- by 6- by 30-inch wooden blocks are placed under the cage, resting on the bottom sloping toward the guides, and the hoisting engineer is signaled to lower the cage until it rests upon the blocks and the hoisting rope is slack. Two workmen mount the cage bonnet, disconnect the main pin and rope socket, and also disconnect the bridle chains. A knock-off hook about 2 feet long, hinged at the bottom, is attached at its top to the rope socket, and two links are connected to the hinged bottom and to the main drawplates. The hinged hook is retained in position by a hinged lever, and both are kept in position by inserting a 20-penny nail in holes through the ends of each to prevent accidental release. The men dismount from the cage, and the engineer is signaled to raise it from the wood-block supports and suspend it on the rope with the knock-off hook in place. One man remounts the cage and removes the safety nail in the end of the lever and hook. A hemp rope is attached to the opposite end of the release lever. The workman again dismounts from the cage to a place of safety on the shaft bottom and gives a downward jerk on the hemp rope, releasing the knock-off hook and main rope. The safety catches functioned when tested and suspended the cage after it had dropped 6 inches. The workmen remount the cage, signal the hoisting engineer to lower the hoisting rope, detach the knock-off hook and links, and reattach the rope socket and bridle chains. The workmen leave the cage, and the hoisting engineer is signaled to raise it. When tension is applied to the hoisting rope and the cage is raised, the safety catches are released and the cage is suspended on the hoisting rope. The wooden blocks placed at the shaft bottom for the test are removed, and the engineer is signaled to lower the cage to the shaft bottom so that normal hoisting can be resumed.

Mine H

The safety-catch mechanism on the man cages at this mine is illustrated in figure 9. The design of the levers and the method of suspension are unlike any of those described heretofore. The wedge-shaped safety catches function somewhat as described under mine F. One spring, in compression during normal hoisting, actuates all the safety catches through the kingpin connection shown in figure 9. The hoisting rope is equipped with an open rope socket, which is connected to the main drawplates through a solid link.

Generated on 2024-09-19 13:52 GMT / https://hdl.handle.net/2027/osu.32435030643894
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

The safety catches are kept disengaged from the cage guides during normal hoisting by the tension in the hoisting rope. The kingpin is in tension when the cage is suspended on the hoisting rope and it is connected at its top by an eye to the horizontal lever, which is one of a system that actuates the safety catches when the hoisting-rope tension is released. The bottom of the kingpin connects with the spring by means of a retaining washer and locknuts. Yellow-pine guides are installed throughout the hoisting distance.

Preliminary to the safety-catch test, a flatcar made from a mine-car truck is run onto the cage; the car supports two 12- by 16-inch timbers somewhat longer than the shaft dimension parallel to the long dimension of the cage. Each of these timbers is surmounted by an 8- by 9-inch timber of equal length, and these, in turn, support short lengths of 6- by 6-inch timbers that are in a position to encounter the cross beam of the cage after the cage is lowered.

The cage is lowered so that its deck with the flatcar is below the surface landing; the timbers span the shaft, and the cage with flatcar is lowered away from them. The cage is lowered until its cross beam rests upon the timbers, which then support the cage while the hoisting rope is slack. Two workmen mount the bonnet of the cage and disconnect the main pin and bridle-chain pins; this releases the hoisting rope and the bridle chains. A knock-off device is inserted between the solid link attached to the rope socket and the main pin, which is through two drawplates. This device consists, from top to bottom, of two clevises, a knock-off hook, and round-iron link. The top clevis is connected to the solid link on the rope socket, and the lower link is connected to the main pin through the drawplates. The hoisting engineer is signaled to raise the cage from the supporting timbers until it is suspended on the hoisting rope about 2-1/2 feet above the timbers. One of the workmen has stationed himself on one of the cross members of the steel head frame and, by stiking the retaining bail of the knock-off hook with a sledge hammer, releases the cage from the hoisting rope. When tension is released from the hoisting rope, the compressed spring expands, the safety-catch levers turn about their fulcrums, and the safety catches rise in their retaining shoes and wedge themselves into the guides. Thus, after the No. 1 cage fell 5-1/2 inches, it was suspended on the cage guides. When the operation was repeated for No. 2 cage, it fell 7-1/2 inches before the safety catches gripped the guides and suspended the cage. The travel of the safety catches in their retaining shoes is controlled by a square-head bolt on the wedge sliding in a slot in the retaining shoe; a small recessed wearing plate is attached to the retaining shoe, so that the square-head bolt cannot turn and the safety catch can move only in a predetermined direction.

The knock-off hook is detached, and the rope socket is reconnected. Some tension is applied to the hoisting rope without disengaging the safety catches, and the fulcrum pins are removed. The cage is then lowered until its cross beam rests upon the timbers across the shaft. This procedure releases the safety catches, and they drop into the disengaged position in their retaining shoes without shock to the hoisting rope. The rope is

Generated on 2024-09-19 13:51 GMT / https://hdl.handle.net/2027/osu.32435030643894
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

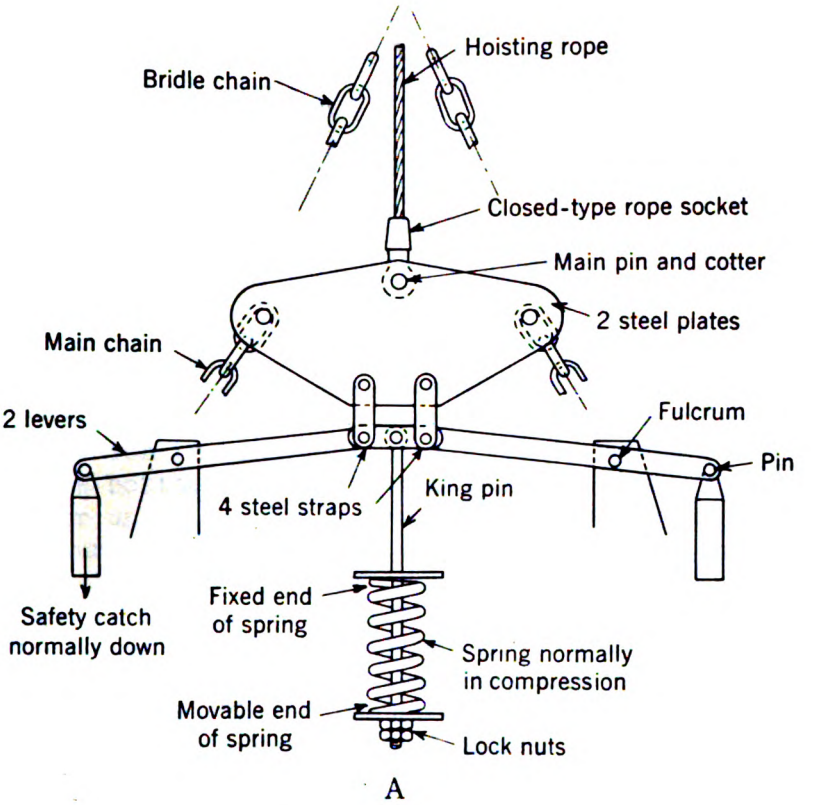

Figure 10.- A, Safety catch control mechanism; B, Knock-off device. Mine 1.

Generated on 2024-09-19 13:50 GMT / https://hdl.handle.net/2027/osu.32435030643894
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

slacked enough by the hoisting engineer to permit reinsertion of the fulcrum pins, and the bridle chains are reconnected.

The cage is raised by the hoisting engineer until the flatcar, which has remained on the cage during the test, engages and lifts the timbers from the surface shaft landing. The flatcar and timbers are pushed from cage No. 1, and cage No. 2 is brought to the surface landing. The car with timbers is run onto cage No. 2; the cage is lowered until the timbers engage and rest upon the shaft landing, whereupon the safety-catch test is repeated for cage 2.

Mine I

The man cage at this mine differs from those usually found at coal mines. It is a single, counterweighted, totally enclosed, double-deck, rigid platform cage, which is used exclusively for hoisting men. Two ramps are constructed at the bottom and two at the top of the shaft, so that both decks can be loaded or unloaded simultaneously. Ten men are permitted on each deck, or a maximum of 20 men exclusive of the operator, who rides with the cage and controls its movement from the upper deck. The hoist that operates the man cage is in the main hoist house, which also contains the hoisting engine for the skip (production) shaft. The man-cage hoist can be operated from either the hoist house or the cage; the change-over from one position of operation to the other takes about 5 minutes. A lock-out device is provided, and it is a safety feature that prevents operation of the man cage simultaneously from both postions. The cage movement was controlled from the hoist house during the safety-catch test.

The hoisting rope is connected to the cage by a closed rope socket. Bridle chains are connected to the hoisting rope above the rope socket by means of a rope clamp with ears, and the bridle-chain connections to the cage are independent of the main connections.

Wedge-shaped safety catches with serrated (toothed) surfaces are installed; the direction of travel of the safety catches is controlled by retaining shoes inclined with the vertical. Seventy-pound rails with their heads toward the center of the man shaft are installed as cage guides throughout the hoisting distance. The man cage is equipped with four safety catches, two for each rail guide. When the safety catches function, they grip the sides of the rail head.

Each safety catch is actuated by a lever that has a fulcrum near the center of the lever. The four levers are connected in such a manner that all are actuated, when tension is released from the hoisting rope, by a single coil spring, which is kept in compression during normal hoisting operations by its kingpin. The kingpin is in tension when tension is in the hoisting rope. The control mechanism is shown in figure 10.

The hoisting engineer is notified of the intent to test the man cage and, with the assistance of one man, changes the position of operation to the platform in the hoist house instead of the upper-cage deck. The

Generated on 2024-09-19 13:51 GMT / https://hdl.handle.net/2027/osu.32435030643894
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

engineer then takes his position on the operating platform in the hoist house. Upon receipt of the proper signal, the empty man cage is lowered until it rests upon wooden blocks at the bottom of the man shaft and the hoisting rope is slack. This places the top deck of the cage about 3 feet below its normal bottom landing. Two workmen proceed to the top of the cage from the upper deck through a trapdoor in the cage bonnet. The bridle chains are disconnected from the cage, and the rope socket is released from between the two main drawplates by removing the main pin connection. A knock-off hook and a link are inserted so that the rope socket is connected to the top of the knock-off hook. The top of the link is in the hook, and the bottom of the link is connected to the main pin. The hoisting engineer is notified through the telephone on the man cage that this step has been completed. The proper signal is given to the engineer, and he operates the hoist so that the cage is lifted from its support until the top-deck platform is 3-1/2 inches from its normal bottom landing. The knock-off hook is equipped with a pivoted releasing lever shaped to form a bail around the hook at one end, whereas a hemp rope is attached to the other end of the lever. The workmen leave the top of the cage and proceed to a place of safety on the bottom landing. One of the workmen then releases the knock-off hook by a quick jerk on the hemp rope; this action releases the hoisting rope. The actuating spring expands, and the safety catches function by gripping the rail heads (guides) and suspend the cage in the shaft after a 6-inch drop. The two workmen again proceed to the top of the cage, and the engineer is signaled to lower the detached hoisting rope and knock-off hook. The knock-off hook is removed from the rope socket, the link is removed from the drawplates, and the rope socket and the bridle chains are reattached to the cage with their normal connections. The men dismount from the cage, and the hoisting engineer is signaled to hoist the cage, whereupon, after tension is in the rope, the actuating spring is recompressed and the safety catches are disengaged. The engineer is signaled to stop the cage and then to return it to the bottom landing. The cage telephone is utilized to notify the hoisting engineer that the safety-catch test has been completed, and he is instructed to make the change-over so that the hoist can be operated from the upper-cage deck. After the change-over, the cage is taken to the surface landing, and the safety catches are examined to determine if they have been damaged as a result of the test.

The Pennsylvania Bituminous Mining Law requires the following code of signals at shafts and slopes where persons, coal, and other materials are hoisted by machinery:

One rap or whistle - to hoist coal.

One rap or whistle - to stop car or cage when in motion.

Two raps or whistles - to lower car or cage.

Three raps or whistles - to hoist persons.

Generated on 2024-09-19 13:52 GMT / https://hdl.handle.net/2027/osu.32435030643894
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

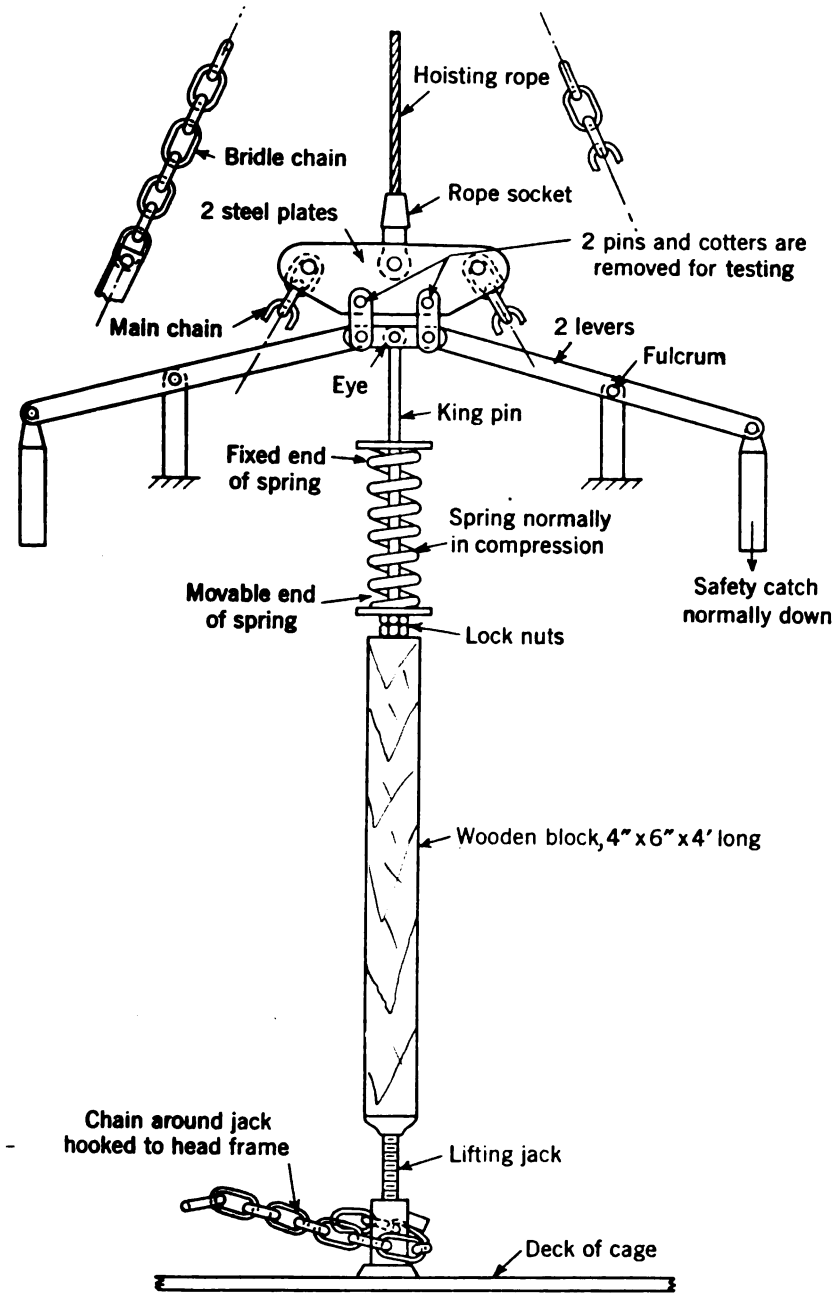

Figure 11.- Method of testing safety catches. Mine J.

Generated on 2024-09-19 13:50 GMT / https://hdl.handle.net/2027/osu.32435030643894
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

The engineer shall signal back when ready, after which the person shall get on the car or cage and then one rap or whistle (two to lower) shall be given to hoist.

Four raps or whistles - to turn on steam to the pumps. (This signal is virtually obsolete.)

The company that operates this Pennsylvania mine has introduced a special hoisting signal code when safety catches are tested, when repairs are made to the cage and its appurtenances, when any repairs are made in the shaft, or when repairs and adjustments are made to the appliances on the head frame or top works. The signal system adopted utilizes loud gongs in the hoist house and at the cage landings and a gong on the man cage, all interconnected, so that when one is operated, the sound is heard at each place on the signal system.

During ordinary man-hoisting, when the cage is operated from the upper deck, the Pennsylvania code of signals is deviated from slightly. The cage operator sounds two bells to lower and three bells to raise. The one-bell signal means to hold the cage at rest. The cage operator sounds the gong to warn persons who may be working on or near the man hoist in the hoist house to stay clear of the hoisting mechanism. A one-bell signal warns the operator not to move the cage but to stop it, if in motion, because of such work in the hoist house or an emergency. A person coming to the man-shaft top or bottom landing signals the operator by two or three bells, respectively, if the cage happens to be at the opposite landing at the time of his arrival; these signals are also heard in the hoist house.

If for some reason the man cage is operated from the hoist house, the Pennsylvania code is followed.

When the safety catches are tested, or when work is done on the shaft or head-frame equipment, each signal is preceded by five bells, and the engineer answers with five bells before the proper raise or lower signal is given. The five-bell signal does not precede the "stop" signal; just one bell is given to stop when the cage is in motion. Under no circumstances will the hoisting engineer move the man cage upon telephone signal only. Some conversation is carried on during the safety-catch test, but only preliminary signals are given by telephone. The shaft signal system must be operated with the correct signals before the engineer will move the cage.

Mine J

The safety-catch mechanism and the method of testing are illustrated in figure 11. The safety catches and the mechanism are similar in design to those described for mines F to I, inclusive, but the method of testing differs from those described previously.

The test for safety-catch effectiveness is conducted at the surface landing. The shaft is not blocked, because neither the rope nor the bridle chains are disconnected during the test. The cage is brought to the surface

Generated on 2024-09-19 14:10 GMT / https://hdl.handle.net/2027/osu.32435030643894
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

landing, and a mechanic further compresses the safety-catch actuating spring by means of a 4- by 6-inch by 4-foot timber and a lifting jack placed under one end of the timber. This action raises the kingpin inside the spring and relieves its pull on the strap connections to the main drawbar plates. The workman then mounts the top of the cage and, by removing two cotter pins, withdraws the pin connections to the main drawbar plates; he then dismounts from the cage. A steel chain is looped around the lifting jack, and the opposite end of it is attached securely to a substantial member of the head frame. The hoisting engineer is signaled to raise the cage until its deck is about 3 feet above the surface landing and then is signaled to lower the cage. When the cage has descended so that its deck is below the surface landing and the slack in the chain is "taken up," the lifting jack is jerked away, the compressed spring expands, and the safety catches function and grip the guides. A test was made in which the safety catches functioned after a drop of 18 inches. The safety catches supported the cage because slack was observed in the hoisting rope and the bridle chains.

The mechanic then entered the cage deck, reset the timber under the spring, which was again compressed by the lifting jack, then went to the top of the cage, reset the pins, which had been disconnected and reinserted the cotter pins. He dismounted from the cage and signaled the hoisting engineer to raise it, whereupon the safety catches were released from the guides when tension was applied to the hoisting rope.

Mine K

Figure 12 illustrates the safety-catch mechanism together with the hoisting rope, main-chain and bridle-chain connections. The hoisting rope is attached to the cage by a closed rope socket, pin-connected between two main steel drawplates. Two main chains connect the main drawplates with the two main cross beams on the cage. Two bridle chains are connected independent of the main chains and extend from a rope clamp above the rope socket to separate connections on the main cross beams of the cage. Cam-shaped safety catches with toothed surfaces are installed at the extremities of each jack shaft and are arranged so that when functioning they will grip the wooden cage guides. One safety catch on each jack shaft has a web cast integral with it; this web serves as a counterweight to assist the gripping action and also prevents the safety catch from overturning when the mechanism functions. The safety catches are kept out of contact with the guides when the cage is suspended on the hoisting rope.

A right-hand bell crank is attached rigidly at its center to one jack shaft; a left-hand bell crank is attached similarly to the other jack shaft. Each bell crank has an upper and a lower arm. A chain with a clevis at its lower end is attached to the upper arm of one bell crank, and the chain is attached by an eye bolt at its upper end to a small angle plate, which is riveted to one of the main drawplates. A second chain is attached to the upper arm of the other bell crank by a similar connection to the small angle plate. The lower arms of the two bell cranks are attached by clevises to a horizontal spring, which is in tension when the hoisting rope and the two

Generated on 2024-09-19 14:19 GMT / https://hdl.handle.net/2027/osu.32435030643894
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

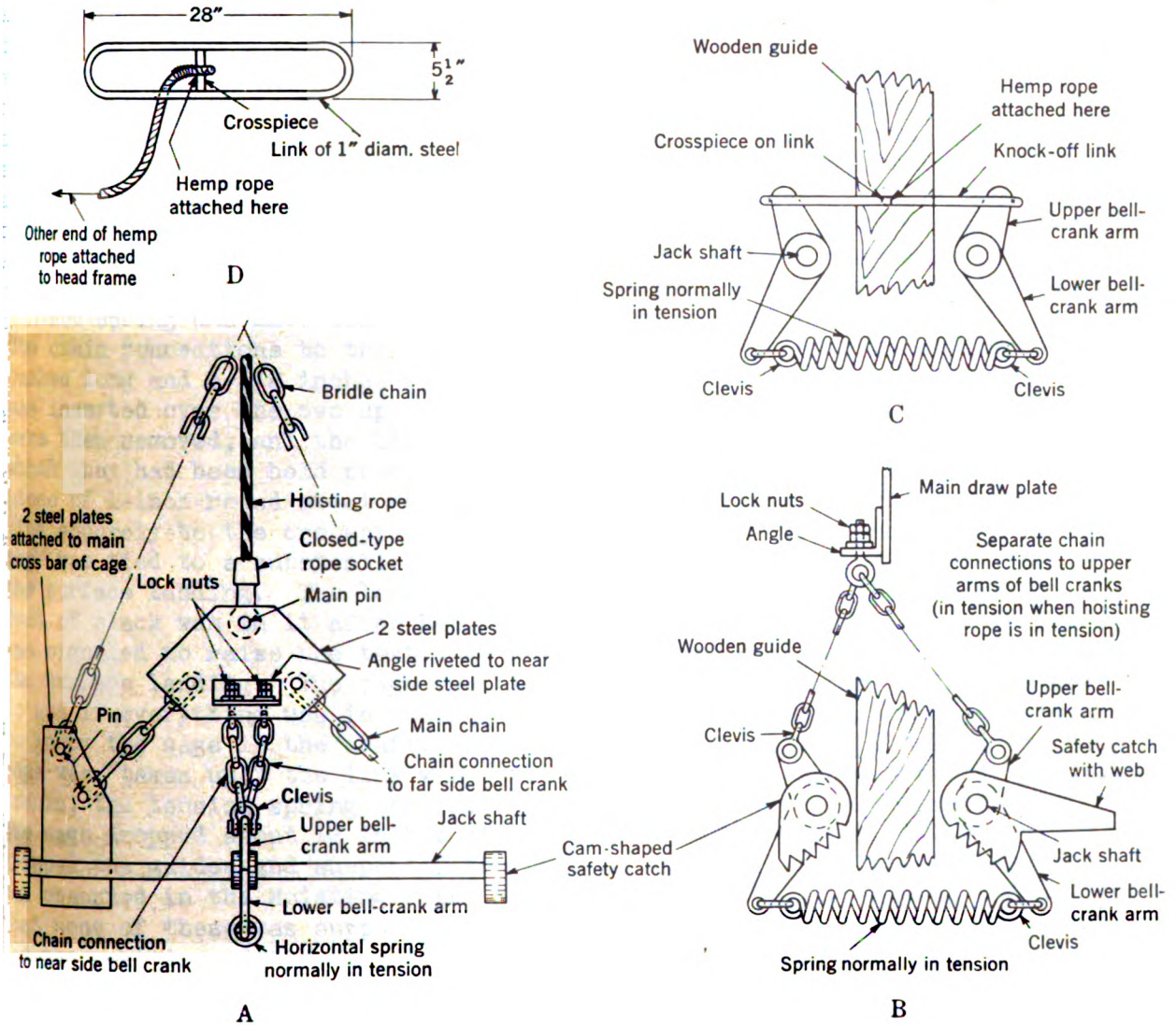

Figure 12.- A, Safety-catch mechanism showing near-side Jack shaft with safety catches and bell crank; B, Shows bell cranks and safety catches in disengaged position when cage is suspended on hoisting rope; C, Knock-off link in position for making safety-catch test; D, Knock-off link. Mine K.

Generated on 2024-09-19 14:08 GMT / https://hdl.handle.net/2027/osu.32435030643894
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

bell-crank connecting chains are in tension. If the hoisting rope breaks, tension is released from the bell-crank connecting chains, the tension spring contracts, and the safety catches turn toward the guides and grip them. The gripping action is assisted by the downward movement of the cage.

Tests for effectiveness of the safety catches are conducted near the surface landing without disconnecting either the hoisting rope, main chains, or bridle chains, and the hoisting shaft is not blocked. The workmen climb on top of the cage bonnet and clean the safety catches of any foreign material that might interfere with their operation. A workman uses a steel bar to force the lower arm of bell cranks outward; obviously, the upper arms turn inward. Wooden blocks were placed under the lower bell-crank arms to hold them in position. This operation further expanded the tension spring and gave slack in the chain connections to the upper arms. The chain connections to the upper arms were removed, and a link about 28 inches long and 5-1/2 inches wide over-all, made of 1-inch round steel, was inserted over the two upper arms of the bell cranks. The wooden blocks were then removed, and the link retained the bell cranks in the position in which they had been held previously by the chains. The link had a crosspiece of 1-inch round steel welded to it near the center. A hemp rope was tied securely to the crosspiece of the link, and the other end of the hemp rope was tied to a substantial member in the head frame about 10 feet above the surface landing. The length of the hemp rope was such that about 20 feet of slack was in it after both ends were secured. The hoisting engineer was signaled to raise the test cage until the deck was about 4 feet above the surface landing. The cage was stopped, and a quick examination was made to see if everything was in readiness for the test. The engineer was signaled to lower the cage in the shaft. As the cage descended, the slack in the hemp rope was "taken up," the link was jerked away from the upper arms of the bell cranks, the tension spring contracted, and the safety catches functioned. The cage dropped about 12 inches after release of the safety catches, which gripped the guides and suspended the cage in the shaft. Considerable slack was observed in the hoisting rope, main chains, and bridle chains, indicative that none of these was supporting the cage. Examination of the safety catches and the position of the cage disclosed that all safety catches functioned. The hoisting engineer raised the cage, after which the safety catches were disengaged. The cage was stopped near the surface landing, and two workmen stepped onto the bonnet. A steel bar was used to turn the bell cranks, which, with the aid of wooden blocks, were forced into position to permit reconnection of the chains to the upper arms of the bell cranks. The chains were reconnected, the wooden blocks were removed, and the workmen descended from the cage.

A hoist in balance utilizing two cages is operated at this mine for hoisting men, supplies, and rock. The second cage was tested immediately after completion of the first cage test by following the same procedure, and similar results were obtained.

Generated on 2024-09-19 13:51 GMT / https://hdl.handle.net/2027/osu.32435030643894
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

DISCUSSION

The most severe condition to which safety catches may be subjected would be a descending cage traveling at its maximum speed, approaching the shaft bottom, loaded with men, and having a rope or a rope-connection failure. This condition would impose upon the cage not only the weight of the men but also the momentum of the descending cage and the weight of the descending rope. The rope weight is not of great importance in bituminous-coal mines, where hoisting shafts are usually shallow in depth. The weight of rope is an important factor in some of the Pennsylvania anthractie mines, and in some deep ore mines the weight of the rope exceeds the weight of the hoisted load.

The safety-catch tests were conducted with empty cages, except at mine H, where the test cage supported a flatcar.

It would be impracticable to simulate the most severe hoisting condition, mentioned above, in making a safety-catch test for effectiveness. Nevertheless, it appears to the writer that the extreme condition is justification for testing a cage loaded at least to the extent of its maximum man-load plus the maximum rope load that may be imposed upon it. For example, a 1-3/8-inch-diameter, 6-strand by 19 wires per strand, wire rope with a hemp core weighs approximately 3 pounds per foot. Assume a shallow shaft 300 feet deep plus 100 feet from the shaft landing to the top of the head sheave; in such a shaft the rope would weigh 1,200 pounds. The mines visited for this study had rules specifying the number of men permitted on a cage at one time, which ranged from a minimum of 10 to a maximum of 20 men. If an average mine worker weighs 160 pounds, 10 workmen would weigh 1,600 pounds. Adding the weight of rope to the weight of the men will give 2,800 pounds. Therefore, when safety catches are tested with an empty cage, the success of the test may give a false sense of security as to the effectiveness of the safety catches. It seems logical to require that the cage should be loaded with at least the maximum load it will be required to support when men are hoisted, because it is conceivable that the safety catches may hold an empty cage and fail to hold a loaded cage.

In most instances the man cages are used for hoisting the mine product or supplies in addition to men. Therefore, it would be a simple matter to place an empty mine car of known weight on the cage and, if necessary, partly load it to at least equal the maximum load the cage would bear when men are transported.

The entire procedure in cage testing is usually under the direction of the master mechanic assisted by shop, surface, or shaft-bottom employees. The place where the test is to be conducted is selected by personal choice. Testing at the surface landing has the advantage of natural illumination and better facilities for making repairs and adjustments should a safety-catch test fail and require repetition.

The writer feels that test 3 does not reproduce the quick release of a hoisting rope, as where the rope is released by a knock-off hook or where a "quick" spring-releasing mechanism is utilized.

Generated on 2024-09-19 13:51 GMT / https://hdl.handle.net/2027/osu.32435030643894
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Some of the State laws referred to in the beginning of this report refer to daily or other periodic examination of the safety catches. Visual examination without testing means little; a test is the only sure method of determining the effectiveness of the safety catches. Some mining companies test more often than the State law requires; one company that cooperated in this study requires the test to be made every 2 weeks, and a written report of the results must be filled out by the person supervising the test. The 2-month interval between safety-catch tests, as provided in the Bituminous Mining Laws of Pennsylvania is the shortest interval specified by any of the State laws; certainly, this is long enough between tests. The time consumed for the safety-catch tests ranged from 30 minutes to less than 1 hour and includes time consumption for hoists in balance involving two cage tests. The writer avers that this is not too great an expenditure of time for so vital a device as the safety catches on cages that are utilized to transport men.

Periodic testing of safety catches at intervals not exceeding 2 months would encourage closer attention to the mechanisms. Where statutory requirements are for longer intervals between tests, or where there are no stated requirements, neglect is likely to occur. Adjustments are necessary from time to time; the levers, bell cranks, pins, etc., may wear excessively at their connecting points; corrosion and excessive friction in the moving parts may develop; ice that forms in winter on top of cages may impede or restrict the movement of the safety catches. Various safety devices are provided by machinery and equipment manufacturers for miscellaneous machinery used in and about mines. Frequent testing of these devices is necessary to insure their proper functioning if an emergency should arise. There is no substitute for a test. The mere physical presence of any safety device may give only a false sense of security; testing should be frequent and under conditions simulating as far as possible those most likely to be present at the time of necessity.

Steel guides were installed in the shaft at two of the mines visited; wooden guides were installed at the other mines. Safety-catch tests did no visible damage to the steel guides, but some slight damage was done to the wooden guides by the embedding of the safety-catch teeth. When safety catches are tested on wooden guides, it is customary to conduct the tests so that the catches grip at a different place on the guides in each test. Most of the tests were made near the surface landing; others were near the shaft bottom. The practice at the mines visited is to have sections of a shorter than usual length installed where the safety-catch tests are made, so that after a certain number of tests are made, say over 2 years, these sections can be removed and new sections installed.

RECOMMENDED PRECAUTIONS

1. The men who participate in the safety-catch test should wear safety belts when they must climb to the top of cages to prevent their falling down an adjacent shaft compartment.

Generated on 2024-09-19 13:51 GMT / https://hdl.handle.net/2027/osu.32435030643894
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

2. Where the test involves releasing the hoisting rope with a knock-off device, a releasing mechanism should be utilized, so that the release may be consummated from a place of safety, and not by requiring a workman to support himself on the head frame or on shaft timbers.

3. The mechanisms should be inspected daily to determine whether undue wear has occurred, that the actuating springs will function, and that the moving parts will be unimpeded in their action because of dirt, corrosion, or ice.

4. The safety catches and the operating mechanism should be examined thoroughly after each test to determine whether the test has caused any damage, and, if so, all necessary repairs and adjustments should be made immediately.

ACKNOWLEDGMENT

The cooperation of the mining-company officials at the 14 large bituminous coal mines where the investigation was made is gratefully appreciated.

Generated on 2024-09-19 13:50 GMT / https://hdl.handle.net/2027/osu.32435030643894
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY